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NASA TECH BRIEF

Marshall Space Flight Center

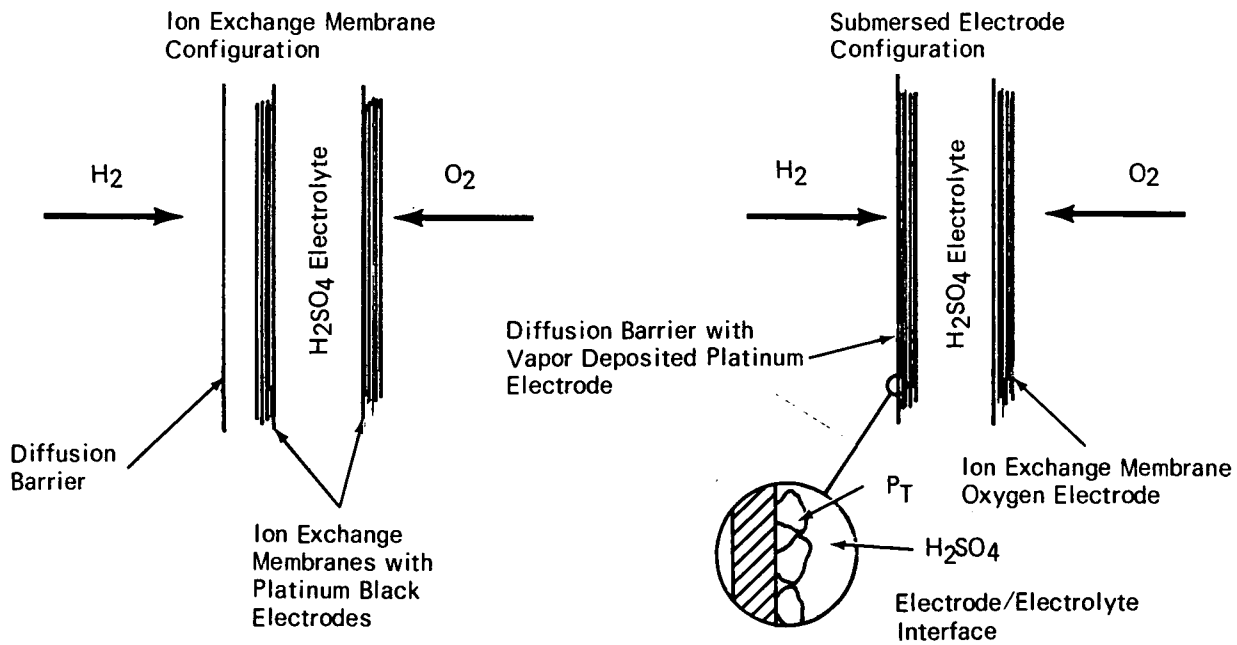
Submersed Sensing Electrode Used in Fuel-Cell Type Hydrogen Detector

The problem:

In the past, hydrogen sensor performance in fuel cell operation has been seriously affected by oxygen-laden diluent gases. A silver-palladium controlled hydrogen leak, for example, while having a higher permeation area than a small foil assembly, failed to provide the anticipated cell output.

The solution:

A submersed sensing electrode used as the hydrogen detector operates as a current-limited device with current positively controlled by a diffusion barrier, such as silicone rubber; the barrier has a fixed permeation constant for hydrogen. By positively limiting the flow of hydrogen to the anode, the Faraday relationship establishes the upper limit for current through the cell. In this case, a diffusion barrier passes a fixed amount of hydrogen for a given partial pressure differential. With the hydrogen partial pressure between the barrier and anode essentially zero, the current becomes a linear function of the hydrogen partial pressure.



How it's done:

The figure presents a schematic comparison of the ion exchange membrane (IEM) and the submersed hydrogen electrode configurations. The IEM configuration has a catalyst, with a finite thickness, that can act as a sink for both hydrogen and oxygen atoms. In addition, the resultant pressure drop

(continued overleaf)

across the catalyst, a drop which the hydrogen must overcome to reach the electrolyte interface, seriously retards sensor operation.

The submersed electrode is fabricated by directly depositing platinum catalyst such as polyphenylene oxide on the diffusion barrier. The assembly is then used to contain the sulphuric acid electrolyte, with the catalyst surface facing into the acid. This configuration results in the following: (a) The free volume between the diffusion barrier and the anode is eliminated, thereby decreasing sensor response time. (b) The pressure drop that the hydrogen atom must overcome between the point of adsorption and the electrode/electrolyte interface is extremely small. (c) The sink of catalyst to adsorb and store oxygen is virtually eliminated. (d) The configuration becomes a close approximation to the infinitely thin catalyst.

Note:

Requests for further information may be directed to:

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Reference: TSP71-10071

Patent status:

No patent action is contemplated by NASA.

Source: Michael D. Rutkoneski, Fred P. Rudek, and Leonard W. Niedrach of General Electric Company under contract to Marshall Space Flight Center (MFS-14655)